HIGH ENERGY EFFICIENCY CHEMICAL PROCESSES FOR ECO-FRIENDLY SYNTHETIC APPLICATIONS

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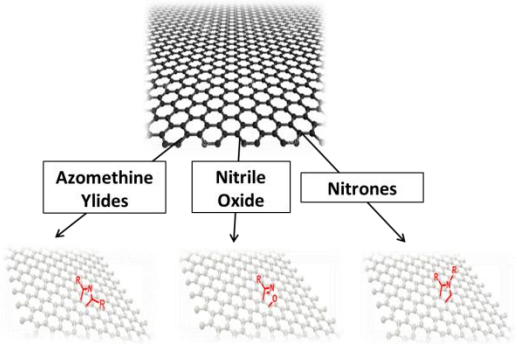
Chemical industries and laboratories are heavily involved in the development of mild, simple, environmentally friendly and inexpensive catalytic processes that adhere to the principles of green chemistry and process intensification, as well as fulfilling competitive production requirements. Currently, the huge gap between classic production processes and new protocols with green technologies, required a stronger interaction to find overlapping areas, in view of higher efficiency and sustainability. In this context we focused our attention in the development of green chemical procedures aimed to save energy, maximize the atom economy and increase process efficiency.

We exploited microwave (MW) irradiation and mechanochemical activation with planetary ball mills in green synthetic protocols. Besides excellent reaction yields these techniques enabled the replacement of organic solvents with benign reaction media, or even solventless.

We applied these new green procedures in different fields: 1) in the synthesis of fine chemicals and highly functionalized macromolecules; 2) in the preparation of new Pd-nanoparticles (NPs) catalyst on cyclodextrin/silica support; and 3) in the field of functionalization and grafting of carbonaceous materials.

Carbon-based nanomaterials have peculiar physical and chemical properties and their unique structure make them truly promising systems. In particular, the scientific community was inspired by graphene, a simple two-dimensional sheet of graphite with nano-size dimension, because of its large potential in different fields, from materials chemistry to drug delivery, imaging and therapy.[1] The surface modification of these carbon materials opens the possibility of tuning their properties in a controlled way. Based on our previous experience on covalent non-conventional functionalization of single-walled carbon nanotubes (SWCNTs)[2,3] and reduced graphene oxide (rGO)[4], we focus our efforts towards the environmentally friendly decoration of rGO. Three different approaches were compared based on 1,3-dipolar cycloaddition of azomethine ylides, nitrile oxide, and nitrones respectively. Real applications require a careful evaluation of functionalization degree by thermogravimetric analyses, FT-IR and Raman.



References:
1. Allen, M. J.; Tung, V. C.; Kaner, R. B. *Chem. Rev.* **2010**, *110*, 132-145.
2. Tagliapietra S.; Cravotto, G.; Calcio Gaudino, E.; Visentin, S.; Mussi, V. *Synlett* **2012**, *23*, 1459-1462.
3. Calcio Gaudino, E.; Tagliapietra, S.; Martina, K.; Barge, A.; Lolli, M.; Terreno, E.; Lembo, D.; Cravotto, G. *Org. Biomol. Chem.* **2014**, *12*, 4708-4715.
4. Bosca, F.; Orio, L.; Tagliapietra, S.; Corazzari, I.; Turci, F.; Martina, K.; Pastero, L.; Cravotto, G.; Barge, A. *Chem. Eur. J.* **2016**, *22*, 1608-1613.